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ABSTRACT

Factor analyses of the Wechsler Intelligence Scale for Children-Revised (WISC-R) have typically yielded three factors: two generally understood to reflect basic verbal and performance dimensions and one about which there is no consensus with regard to what is measured. The aim of the present study is to elaborate the meaning of the third factor by examining the relationship between performance on the arithmetic, coding, and digit span subtests of the WISC-R and a variety of other cognitive and behavioral measures, especially measures which reflect developmental changes in information processing skills or strategies. Subjects were 96 fifth-grade children, 54 boys and 42 girls, who scored within the normal range of intelligence on a group IQ test. Children were seen in two sessions about 10 days apart. During the first session, six subtests of the WISC-R were administered. Then, during the second session, comprehension monitoring tasks, serial recall tasks, and modified serial recall tasks for assessing study strategies were completed by the children. Additionally, total reading and total math achievement scores from the comprehensive Test of Basic Skills as well as total IQ scores from the Short Form Test of Academic Aptitude were collected. Results of canonical correlation and regression analyses are discussed. (RH)

The Relationship between WISC-R "Freedom from Distractibility" Subtests and Selected Measures of Achievement, Comprehension Monitoring, Self-Testing, and Other Recall Strategies

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The Relationship Between WISC-R "Freedom from Distractibility" Subtests and Selected Measures of Achievement, Comprehension Monitoring, Self-Testing, and Other Recall Strategies

Factor analyses of the Wechsler Intelligence Scale for Children-Revised (WISC-R) have typically yielded three factors. The first two are generally understood to reflect basic verbal and performance dimensions that Wechsler intended to build into the test. The third factor, on which Arithmetic, Coding, and Digit Span subtests load highest, is less clearly interpreted. Kaufman (1975) labeled this factor "Freedom from Distractibility" primarily for historical reasons, based on factor analyses of other Wechsler tests. Other authors have suggested that this factor reflects memory (Cohen, 1957), numerical ability (Osborn & Lindsey, 1967; Wikoff, 1978), or, more generally, "a cognitive ability" (Kaufman, 1979). At present there is no consensus about just what it is that the subtests of the third factor are measuring; therefore, it is difficult for the test user to provide a precise interpretation of performance on these subtests.

The aim of the present study was to elaborate the meaning of the third factor by examining the relationship between performance on these three WISC-R subtests and a variety of other cognitive and behavioral measures, especially several measures that have been shown to reflect developmental changes in information-processing skills or strategies. As Glaser (1981) suggested in his discussion of assessment practices, increased understanding of the cognitive structures and strategies underlying competent performance is important as a means of comprehending the transformation of a novice into an expert. Thus, if we can gain insight into cognitive processes which can predict performance on the three WISC-R subtests, the possibility of a more meaningful interpretation of performance should be increased.

Research participants were 96 fifth grade children, 54 boys and 42 girls, from schools in a suburban Southern community. All participants in the study were within the normal range of intelligence according to a group IQ test.

Children were seen in two sessions, about ten days apart. During the first session, six subtests of the WISC-R were administered. The Information subtest was given first, primarily as a warm-up procedure. Vocabulary and Block Design were included to provide an estimate of full-scale IQ, and the three third-factor subtests (Arithmetic, Coding, and Digit Span) were administered. Subtests were administered in the standard order.

During the second session, children received several tasks designed to assess several aspects of information-processing skill. Comprehension monitoring was assessed in the first two tasks. The first task employed three tape-recorded stories 130-150 words in length, adapted from Markman (1979). Each was constructed so that information presented in two parts of the story was explicitly contradictory. (For example, one story was about fish that lived at the bottom of the sea where it was so dark that nothing could be seen, and told about how they identified their food by its color.) The child was asked to evaluate the story by telling whether it was easy to understand or if it made sense. If the child did not spontaneously report the inconsistency after hearing the story two times, the experimenter asked a series of questions designed to progressively direct the child's attention to the contradictory information. The child's score was the number of the question at which he or she first clearly described the problem in the content of the story. Three stories were presented in varying orders. The second task used to assess comprehension monitoring was the Missing Elements subtest of the KeyMath test, which appeared to us to measure a similar ability of the child to attend to and integrate information. This test requires the child to tell what information has been omitted from an arithmetic problem presented in story form, information that is necessary if the problem is to be solved.

Next, the child was given a variation of a serial recall task, using sets of two to ten pictures. The child was asked to recall the items in the order of presentation. The child's memory span for this task was indexed by the longest sequence of pictures that could be correctly recalled.

Then, following a procedure that has been used by several other investigators (e.g, Flavell, Friedrichs, & Hoyt, 1970; Brown & Barclay, 1977; Moely, Leal, Taylor, & Gaines, 1981), a modified serial recall task was employed to assess the child's use of various study strategies as he or she prepared to demonstrate recall of a set of pictures. Line drawings were mounted on cards and placed for presentation in the "windows" of a wooden apparatus. The "windows" were aligned in a row of ten; the child received a set of pictures for serial recall equal to his or her memory span on the picture task plus one additional item. On an initial practice trial, the child was instructed to study the pictures until he or she was ready to recall them in order from left to right, and to ring a bell located on the table near the apparatus when ready to recall. Instructions indicated that the child was to expose only one of the windows at a time; otherwise, the experimenter did not direct the child toward to use of any particular study technique. Three trials were given, following the practice trial, with a new set of items presented on each trial. The experimenter observed the children during study and recorded study behaviors observed during each ten-second interval. Study behaviors recorded included the child's use of self-testing strategies of anticipation or cumulative rehearsal. (In anticipation, the child says the name of an item before opening a window to check on what is behind it. In cumulative rehearsal, the child says the names of several items consecutively without exposing them to view in the windows.) Often the child would gesture toward the windows during study; gesturing was also recorded. Less sophistocated strategies for study included simply looking at the pictures or naming the pictures while looking at them. The child's score for each study behavior was the proportion of all ten-second intervals on a given trial in which that study behavior was observed to occur. The experimenter also recorded any instances of distraction, in which the child was off-task for a period of two seconds or more, and recorded the total length of time that the child studied before ringing the bell. At the end of the task, the experimenter asked the child two questions designed to elicit information about the kinds of study strategies the child had used and about how the child had decided when to stop studying. Verbatim answers were recorded, along with answers to followup questions given to clarify ambiguous responses; answers were scored so as to indicate the relative sophistication of study and self-testing strategies reported.

In addition to the data already described, Total Reading and Total Math Achievement scores from the fifth-grade administration of the Comprehensive Test of Basic Skills were obtained from the child's school records. In addition, Total IQ scores from the concurrent administration of the Short Form Test of Academic Aptitude were collected as a measure of general cognitive ability.

The strategy for data analysis was to select groups of variables that were assumed to measure related skills and to use canonical correlation and regression analyses in order to investigate patterns of relationship between these groups and the three subtests of the WISC-R third factor. Table 1 of your handout shows means and standard deviations of each of the measures. Table 2 summarizes the results of the analyses used to identify relationships between groups of variables, and Table 3 shows intercorrelations of the WISC-R subtest scores with each of the other cognitive measures. The results of the analyses indicate that a number of the cognitive and behavioral measures included in the present study are related to performance on the WISC-R third factor-subtests.

A canonical correlation analysis showed that the third factor subtests were significantly related to the comprehension monitoring cluster. Regression analyses used to predict each of the WISC-R subtests from the two comprehension monitoring measures indicated that Arithmetic could be significantly predicted, largely because of the strong relationship between that subtest and the Missing Elements subtest of the KeyMath. According to regression analyses, neither Digit Span nor Coding were related to the comprehension monitoring measures.

Memory span for pictures was related significantly to the Digit Span subtest, but not to either of the others.

The canonical correlation between the three WISC-R subtests and the self-testing measures showed a significant relationship between the two sets. (The self-testing measures included the time the child spent studying for recall, correctness of serial recall, use of anticipation/rehearsal strategies, and the child's answers to the two questions given at the end of the task; all of these measures were quite substantially intercorrelated.) Regression analyses used to predict each of the subtests from the self-testing measures indicated that both Arithmetic and Coding, but not Digit Span, could be predicted.

For the Arithmetic subtest, both the child's use of anticipation/rehearsal as a study strategy and the child's report of having used such a strategy as a way of deciding when to stop studying were important contributors to the prediction, as shown through comparisons of complete and reduced regression models. When either of these variables was deleted from the set of predictor variables, prediction of Arithmetic subtest scores was significantly reduced. The removal of any other measures involved in the self-testing cluster, either singly or in combination, failed to affect the degree to which performance on the Arithmetic subtest could be predicted.

For the Coding subtest, anticipation/rehearsal again proved to be important, in that prediction was significantly reduced when it was omitted from the regression equation. Prediction was also affected by omission of the measure indexing the child's report of study strategies used in preparation for recall.

The WISC-R subtests were not related significantly to other strategies used in serial recall (looking, naming, or gesture), according to a canonical correlation, and also were unrelated to the child's tendency to be distracted from the serial recall task (although little distraction occurred on this relatively structured task).

Achievement/IQ measures were found to be related to the third factor subtests. Regression analyses indicated that both Arithmetic and Coding could be predicted from these measures, while Digit Span could not. Math achievement was important to the prediction of both Arithmetic and Coding. When the math achievement measure was omitted from the regression equations for either Arithmetic or Coding, prediction was reduced significantly. There was also a tendency for reduced prediction of Arithmetic when the SFTAA IQ measure was omitted from the regression equation.

In summary, then, we found that the three WISC-R subtests as a group were related to several clusters of measures, including comprehension monitoring, self-testing, and achievement/IQ. When relationships were examined for each of the three WISC-R subtests separately, it was found that Arthmetic and Coding were most consistently related to these clusters. Digit Span showed a different pattern, in that it as a single measure was significantly related only to another measure of serial memory; it was not related to the comprehension monitoring, self-testing, or achievement/IQ clusters. Measures which were important for prediction of performance on the Arithmetic subtest included the Missing Elements subtest of Keymath, anticipation/rehearsal and the child's reported use of self-testing as a means of deciding when to stop studying, math achievement, and (to a lesser extent) general cognitive ability as measured by the SFTAA. Thus, performance on the Arithmetic subtest appears to be related to the child's tendency to use active rehearsal and self-testing strategies in a task, to the ability to comprehend and integrate verbal information presented in the context of math problems, numerical ability, a cognitive ability to comprehend relationships, and an awareness of when the appropriate response has been achieved. The Coding subtest appears to tap some related skills, including the use of self-testing strategies and numerical ability as assessed in a math achievement test, but it is less related to comprehension monitoring of understanding of mathematical problems or to general cognitive skills as assessed by the SFTAA than is the Arithmetic subtest.

In general, the findings of this study suggest that to label the third factor subtests of the WISC-R as simply a measure of "Freedom from Distractibility" is an over-simplification. In fact, fairly complex cognitive processes, rather than merely the behavioral dimension of distraction, appear to underlie performance on these subtests. No single cognitive construct appears to underlie the three tests, however. While Arithmetic and Coding share common variance with several measures of active strategy use and cognitive skill, Digit Span is relatively distinct and apparently less reliant on the kinds of abilities assessed here.

References

Brown, A. L., & Barclay, C. R. The effects of training specific mnemonics on the metamnemonic efficiency of retarded children. Child Development, 1976, 47, 70-80.

Cohen, J. The factorial structure of the WAIS between early adulthood and old age. Journal of Consulting Psychology, 1957, 21, 283-290.

Flavell, J. H., Friedrichs, A. G., & Hoyt, J. D. Developmental changes in memorization processes. Cognitive Psychology, 1970, 1, 324-340.

Glaser, R. The future of testing: A research agenda for cognitive psychology and psychometrics. American Psychologist, 1981, 36, 923-936.

Kaufman, A. S. Factor analysis of the WISC-R at 11 age levels between 6 1/2 and 16 1/2 years. Journal of Consulting and Clinical Psychology, 1975, 43, 135-147.

Kaufman, A. S. Intelligent testing with the WISC-R. New York: Wiley-Interscience, 1979.

Markman, E. M. Realizing that you don't understand: Elementary school children's awareness of inconsistencies. Child Development, 1979, 50, 643-655.

Moely, B. E., Leal, L., Taylor, E., & Gaines, J. G. Memory in learning disabled children: Strategy use, self-monitoring, and metamemory. Paper presented at the meeting of the American Psychological Association, Los Angeles, August, 1981.

Osborn, R. T., & Lindsey, J. M. A longitudinal investigation of changes in the factorial composition of intelligence with age in young school children. Journal of Genetic Psychology, 1967, 110, 49-58.

Table 1

Means and Standard Deviations on Each Variable for 96 Fifth Grade Children

	Third Factor Subtests			Comprehension Monitoring		Memory Span
	Arithmetic	Coding	Digit Span	Stories	KeyMath Subtest	
$\overline{X}$ =	9.17	10.16	10.0	10.61	5.41	4.86
SD =	2.21	2.39	2.55	10.23	1.80	.66

	Self-testing Measures					Other Strategies			
	Anticipation/ Rehearsal	Time Studying	Recall	Reported strategy use	Reported self-test	Looking	Naming	Gesture	Distracted
$\overline{X}$ =	1.198	119.24	1.38	2.35	1.22	2.995	2.758	.181	.003
SD =	.832	55.46	1.10	.89	.95	.325	.496	.494	.026

	Achievement/IQ Measures			
	CTBS Math Achievement	CTBS Reading Achievement	SFTAA IQ	WISC-R IQ
$\overline{X}$ =	5.56	6.32	101.51	99.71
SD =	1.35	1.69	8.92	11.36

Table 2

Findings of Canonical Correlation and Multiple Regression Analyses for Variables Related to WISC-R Third Factor Subtests

Third Factor Subtests (Arithmetic, Coding, Digit Span) and Measures of Comprehension Monitoring (Storeis, Missing Elements Subtest of KeyMath)

Canonical Correlation Analysis: Rao's Approximate $F(6, 182) = 2.149$, $p < .05$

Multiple Regression Analyses:

Predicting Arithmetic: $R = .332$, $F(3, 92) = 3.802$, $p < .02$
Reduced model, omitting KeyMath subtest, differs from complete model, $F(1, 92) = 8.714$, $p < .005$

Third Factor Subtests and Memory Span for Pictures

Multiple Regression Analysis:

Predicting Digit Span from Memory Span for Pictures: $R = .408$, $F(1, 94) = 18.752$, $p < .001$

Third Factor Subtests and Self-Testing (Anticipation/Rehearsal, Recall, Time Spent Studying, Self-Reports of Strategy Use and Self-Testing)

Canonical Correlation Analysis: Rao's Approximate $F(15, 243) = 2.077$, $p < .02$

Multiple Regression Analyses:

Predicting Arithmetic: $R = .368$, $F(5, 90) = 2.824$, $p < .03$
Reduced model, omitting Anticipation/Rehearsal, differs from complete regression model, $F(1, 90) = 4.058$, $p < .04$
Reduced model, omitting Self-Report of Self-Testing, differs from complete regression model, $F(1, 90) = 4.985$, $p < .03$

Predicting Coding: $R = .351$, $F(5, 90) = 2.534$, $p < .04$
Reduced model, omitting Anticipation/Rehearsal, differs from complete regression model, $F(1, 90) = 4.916$, $p < .03$
Reduced model, omitting Self-Report of Strategy Use, differs from complete regression model, $F(1, 90) = 5.186$, $p < .03$

Third Factor Subtests and Achievement/IQ Measures (CTBS Reading and Math Achievement, Short Form Test of Academic Aptitude IQ, Estimated WISC-R IQ)

Canonical Correlation Analysis: Rao's Approximate $F(12, 236) = 3.255$, $p < .001$

Multiple Regression Analyses:

Predicting Arithmetic: $R = .481$, $F(4, 91) = 6.836$, $p < .001$
Reduced model, omitting Math Achievement, differs from complete regression model, $F(1, 91) = 13.815$, $p < .001$
Reduced model, omitting SFTAA IQ, tends to differ from complete regression model, $F(1, 91) = 3.555$, $p = .059$

Predicting Coding: $R = .324$, $F(4, 91) = 2.677$, $p < .04$
Reduced model, omitting Math Achievement, differs from complete regression model, $F(1, 91) = 3.859$, $p < .05$

Table 3

Intercorrelations of WISC-R Third Factor Subtests and Measures

Assessing Comprehension Monitoring, Self-Testing Strategies,

Serial Memory, Achievement, and IQ (N = 96 Fifth Graders)

Third Factor Subtests	Comprehension Monitoring: KeyMath Subtest	Comprehension Monitoring: Stories	Memory span	Anticipation/ rehearsal	Serial Recall Task Self-Testing Measures: Reported self-test	Serial Recall Task Self-Testing Measures: Reported strategy	Serial Recall Task Self-Testing Measures: Recall	Serial Recall Task Self-Testing Measures: Time studying	CTBS Achievement: Reading	CTBS Achievement: Math	CTBS Achievement: SFTAA	IQ: WISC-R Estimate
Arithmetic	.29	.06	.18	.29	.29	.14	.14	.20	.16	.45	.32	.12
Coding	.14	-.06	.07	.19	-.01	.18	.07	-.01	.25	.29	.19	.13
Digit span	.03	-.08	.41	.17	.27	.19	.09	.20	.16	.08	.16	.14